

A

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

JC662
66/86
U.S. PTO

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 8236-053-999 Total Pages 47

First Named Inventor or Application Identifier

Robert J. Duffy et al.

Express Mail Label No. EL 452 480 285 US

08/23/98

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

Assistant Commissioner for Patents
ADDRESS TO: Box Patent Application
Washington, DC 20231

1. Fee Transmittal Form
Submit an original, and a duplicate for fee processing

2. Specification [Total Pages 35]
(preferred arrangement set forth below)
-Descriptive title of the Invention
-Cross Reference to Related Applications
-Statement Regarding Fed sponsored R&D
-Reference to Microfiche Appendix
-Background of the Invention
-Brief Summary of the Invention
-Brief Description of the Drawings *(if filed)*
-Detailed Description of the Invention (including drawings, *if filed*)
-Claim(s)
-Abstract of the Disclosure

3. Drawing(s) *(35 USC 113)* (formal) [Total Sheets 8]

4. Oath or Declaration [Total Sheets 2]
a. Newly executed (original or copy)
b. Copy from a prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 17 completed)
[Note Box 5 below]
i. **DELETION OF INVENTOR(S)**
Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33 (b).

5. Incorporation By Reference *(useable if Box 4b is checked)*
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. Microfiche Computer Program *(Appendix)*

7. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. Computer Readable Copy
b. Paper Copy *(identical to computer copy)*
c. Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. Assignment Papers (cover sheet & document(s))

9. 37 CFR 3.73(b) Statement Power of Attorney *(when there is an assignee)*

10. English Translation Document *(if applicable)*

11. Information Disclosure Statement (IDS)/PTO-1449 Copies of IDS Citations

12. Preliminary Amendment

13. Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)

14. Small Entity Statement filed in prior application, Statement(s) Status still proper and desired

15. Certified Copy of Priority Document(s)
(if foreign priority is claimed)

16. Other: Recorded Assignment

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

Continuation Divisional Continuation-in-part (CIP) of prior application 08/871.307
filed on June 9, 1997.

18. CORRESPONDENCE ADDRESS

Customer Number or Bar Code Label 20582
(Insert Customer No. or Attach bar code label here) or Correspondence address below

NAME					
ADDRESS					
CITY	STATE	ZIP CODE			
COUNTRY	TELEPHONE	FAX			

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Prior application: Examiner Mendez, M.
 Art Unit 3734

Assistant Commissioner for Patents
 BOX PATENT APPLICATION
 Washington, D.C. 20231

Sir:

This is a request for filing a continuation divisional application under 37 CFR § 1.53(b), of pending prior application no. 08/871,307 filed on 06/09/97.

Of Robert J. Duffy, Lon M. Severe, Edward M. Richards, Shawn W. Dekalb and James P. Stewart
 (inventor(s) currently of record in prior application)

For Method and Apparatus for Power Connection in a Modular Patient Care System
 (title of invention)

1. The filing fee is calculated below:

PATENT APPLICATION FEE VALUE

TYPE	NO. FILED	LESS	EXTRA	EXTRA RATE	FEE
Total Claims	9	-20	0	\$18.00 each	\$ 0.00
Independent	1	-3	0	\$78.00 each	\$ 0.00
Basic Fee					\$ 760.00
Multiple Dependency Fee If Applicable (\$260.00)					\$
Total					\$ 760.00
50% Reduction for Independent Inventor, Nonprofit Organization or Small Business Concern					- \$ 0.00
Total Filing Fee					\$ 760.00

2. Please charge the required fee to Pennie & Edmonds LLP Deposit Account No. 16-1150 [order no. 8236-053-999]. A copy of this sheet is enclosed.

3. Amend the specification by inserting before the first line the following sentence: This is a continuation of application no. 08/871,307, filed 06/09/97.

4a. Transfer the drawings from the prior application to this application and abandon the prior application as of the filing date accorded this

application. A duplicate copy of this sheet is enclosed for filing in the prior application file.

- 4b. New formal drawings are enclosed.
- 4c. Informal drawings are enclosed.
- 5a. Priority of application no. filed on in is claimed under 35 U.S.C. §119.
- 5b. The certified copy has been filed in prior application no. , filed .
- 6. The prior application is assigned of record to Alaris Medical Systems, Inc.
- 7a. The Power of Attorney appears in the original papers in the prior application no. 08/871,307, filed 06/09/97.
- 7b. Since the Power of Attorney does not appear in the original papers, a copy of the Power in prior application no. , filed is enclosed.
- 8. This application contains nucleic acid and/or amino acid sequences required to be disclosed in a Sequence Listing under 37 CFR §§1.821-1.825. It is requested that the Sequence Listing in computer readable form from prior application no., filed on be made a part of the present application as provided for by 37 C.F.R. §1.821(e). The sequences disclosed therein are the same as the sequences disclosed in this application. A copy of the paper Sequence Listing from application no. is enclosed.
- 9. The undersigned states, under 37 C.F.R. §1.821(f), that the content of the enclosed paper Sequence Listing from application no. is the same as the content of the computer readable form submitted in application no.
- 10. Additional enclosures or instructions. A copy of the Declaration and Power of Attorney and Recorded Assignment from prior application serial no 08/871,307 filed 6/9/97. *Also, preliminary amendment.*

Respectfully submitted,

Date

8/23/99



Thomas D. Kohler

32,797

Reg. No.

PENNIE & EDMONDS LLP
1155 Avenue of the Americas
New York, N.Y. 10036-2711
(650) 849-7706

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of: Duffy *et al.*

Application No.: 09/unknown

Group Art Unit: unknown

Filed: August 23, 1999

Examiner: unknown

For: METHOD AND APPARATUS FOR POWER
CONNECTION IN A MODULAR PATIENT
CARE SYSTEM

Attorney Docket No.: 8236-053-999

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to the examination of the above-captioned application, please consider the following amendments and comments.

IN THE CLAIMS

Please cancel Claims 1-18 without prejudice.

IN THE SPECIFICATION

At page 1, line 12, before the phrase "and assigned", please insert "now U.S. Pat. No. 5,713,856."

At page 1, line 16, please replace "U.S. Pat. App. Ser. No. ____/_____, filed ____" with "U.S. Pat. App. Ser. No. 08/866,664, filed June 9, 1997."

At page 1, line 18, before the phrase "both assigned," please insert "now U.S. Pat. No. 5,836,910."

Respectfully submitted,

Date

8/23/99

Says I Will Do For

32,797

Thomas D. Kohler

(Reg. No.)

PENNIE & EDMONDS LLP
1155 Avenue of the Americas
New York, New York 10036-2711
(212) 790-9090

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
289
290
291
292
293
294
295
296
297
298
299
299
300
301
302
303
304
305
306
307
308
309
309
310
311
312
313
314
315
316
317
318
319
319
320
321
322
323
324
325
326
327
328
329
329
330
331
332
333
334
335
336
337
338
339
339
340
341
342
343
344
345
346
347
348
349
349
350
351
352
353
354
355
356
357
358
359
359
360
361
362
363
364
365
366
367
368
369
369
370
371
372
373
374
375
376
377
378
379
379
380
381
382
383
384
385
386
387
388
389
389
390
391
392
393
394
395
396
397
398
399
399
400
401
402
403
404
405
406
407
408
409
409
410
411
412
413
414
415
416
417
418
419
419
420
421
422
423
424
425
426
427
428
429
429
430
431
432
433
434
435
436
437
438
439
439
440
441
442
443
444
445
446
447
448
449
449
450
451
452
453
454
455
456
457
458
459
459
460
461
462
463
464
465
466
467
468
469
469
470
471
472
473
474
475
476
477
478
479
479
480
481
482
483
484
485
486
487
488
489
489
490
491
492
493
494
495
496
497
498
499
499
500
501
502
503
504
505
506
507
508
509
509
510
511
512
513
514
515
516
517
518
519
519
520
521
522
523
524
525
526
527
528
529
529
530
531
532
533
534
535
536
537
538
539
539
540
541
542
543
544
545
546
547
548
549
549
550
551
552
553
554
555
556
557
558
559
559
560
561
562
563
564
565
566
567
568
569
569
570
571
572
573
574
575
576
577
578
579
579
580
581
582
583
584
585
586
587
588
589
589
590
591
592
593
594
595
596
597
598
599
599
600
601
602
603
604
605
606
607
608
609
609
610
611
612
613
614
615
616
617
618
619
619
620
621
622
623
624
625
626
627
628
629
629
630
631
632
633
634
635
636
637
638
639
639
640
641
642
643
644
645
646
647
648
649
649
650
651
652
653
654
655
656
657
658
659
659
660
661
662
663
664
665
666
667
668
669
669
670
671
672
673
674
675
676
677
678
679
679
680
681
682
683
684
685
686
687
688
689
689
690
691
692
693
694
695
696
697
698
698
699
699
700
701
702
703
704
705
706
707
708
709
709
710
711
712
713
714
715
716
717
718
719
719
720
721
722
723
724
725
726
727
728
729
729
730
731
732
733
734
735
736
737
738
739
739
740
741
742
743
744
745
746
747
748
749
749
750
751
752
753
754
755
756
757
758
759
759
760
761
762
763
764
765
766
767
768
769
769
770
771
772
773
774
775
776
777
778
779
779
780
781
782
783
784
785
786
787
788
789
789
790
791
792
793
794
795
796
797
798
799
799
800
801
802
803
804
805
806
807
808
809
809
810
811
812
813
814
815
816
817
818
819
819
820
821
822
823
824
825
826
827
828
829
829
830
831
832
833
834
835
836
837
838
839
839
840
841
842
843
844
845
846
847
848
849
849
850
851
852
853
854
855
856
857
858
859
859
860
861
862
863
864
865
866
867
868
869
869
870
871
872
873
874
875
876
877
878
879
879
880
881
882
883
884
885
886
887
888
889
889
890
891
892
893
894
895
896
897
898
898
899
899
900
901
902
903
904
905
906
907
908
909
909
910
911
912
913
914
915
916
917
918
919
919
920
921
922
923
924
925
926
927
928
929
929
930
931
932
933
934
935
936
937
938
939
939
940
941
942
943
944
945
946
947
948
949
949
950
951
952
953
954
955
956
957
958
959
959
960
961
962
963
964
965
966
967
968
969
969
970
971
972
973
974
975
976
977
978
979
979
980
981
982
983
984
985
986
987
988
989
989
990
991
992
993
994
995
996
997
998
998
999
999
1000
1001
1002
1003
1004
1005
1006
1007
1008
1009
1009
1010
1011
1012
1013
1014
1015
1016
1017
1018
1019
1019
1020
1021
1022
1023
1024
1025
1026
1027
1028
1029
1029
1030
1031
1032
1033
1034
1035
1036
1037
1038
1039
1039
1040
1041
1042
1043
1044
1045
1046
1047
1048
1049
1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1059
1060
1061
1062
1063
1064
1065
1066
1067
1068
1069
1069
1070
1071
1072
1073
1074
1075
1076
1077
1078
1079
1079
1080
1081
1082
1083
1084
1085
1086
1087
1088
1089
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1098
1099
1099
1100
1101
1102
1103
1104
1105
1106
1107
1108
1109
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1119
1120
1121
1122
1123
1124
1125
1126
1127
1128
1129
1129
1130
1131
1132
1133
1134
1135
1136
1137
1138
1139
1139
1140
1141
1142
1143
1144
1145
1146
1147
1148
1149
1149
1150
1151
1152
1153
1154
1155
1156
1157
1158
1159
1159
1160
1161
1162
1163
1164
1165
1166
1167
1168
1169
1169
1170
1171
1172
1173
1174
1175
1176
1177
1178
1179
1179
1180
1181
1182
1183
1184
1185
1186
1187
1188
1189
1189
1190
1191
1192
1193
1194
1195
1196
1197
1198
1198
1199
1199
1200
1201
1202
1203
1204
1205
1206
1207
1208
1209
1209
1210
1211
1212
1213
1214
1215
1216
1217
1218
1219
1219
1220
1221
1222
1223
1224
1225
1226
1227
1228
1229
1229
1230
1231
1232
1233
1234
1235
1236
1237
1238
1239
1239
1240
1241
1242
1243
1244
1245
1246
1247
1248
1249
1249
1250
1251
1252
1253
1254
1255
1256
1257
1258
1259
1259
1260
1261
1262
1263
1264
1265
1266
1267
1268
1269
1269
1270
1271
1272
1273
1274
1275
1276
1277
1278
1279
1279
1280
1281
1282
1283
1284
1285
1286
1287
1288
1289
1289
1290
1291
1292
1293
1294
1295
1296
1297
1298
1298
1299
1299
1300
1301
1302
1303
1304
1305
1306
1307
1308
1309
1309
1310
1311
1312
1313
1314
1315
1316
1317
1318
1319
1319
1320
1321
1322
1323
1324
1325
1326
1327
1328
1329
1329
1330
1331
1332
1333
1334
1335
1336
1337
1338
1339
1339
1340
1341
1342
1343
1344
1345
1346
1347
1348
1349
1349
1350
1351
1352
1353
1354
1355
1356
1357
1358
1359
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
1369
1370
1371
1372
1373
1374
1375
1376
1377
1378
1379
1379
1380
1381
1382
1383
1384
1385
1386
1387
1388
1389
1389
1390
1391
1392
1393
1394
1395
1396
1397
1398
1398
1399
1399
1400
1401
1402
1403
1404
1405
1406
1407
1408
1409
1409
1410
1411
1412
1413
1414
1415
1416
1417
1418
1419
1419
1420
1421
1422
1423
1424
1425
1426
1427
1428
1429
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439
1439
1440
1441
1442
1443
1444
1445
1446
1447
1448
1449
1449
1450
1451
1452
1453
1454
1455
1456
1457
1458
1459
1459
1460
1461
1462
1463
1464
1465
1466
1467
1468
1469
1469
1470
1471
1472
1473
1474
1475
1476
1477
1478
1479
1479
1480
1481
1482
1483
1484
1485
1486
1487
1488
1489
1489
1490
1491
1492
1493
1494
1495
1496
1497
1498
1498
1499
1499
1500
1501
1502
1503
1504
1505
1506
1507
1508
1509
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1519
1520
1521
1522
1523
1524
1525
1526
1527
1528
1529
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1539
1540
1541
1542
1543
1544
1545
1546
1547
1548
1549
1549
1550
1551
1552
1553
1554
1555
1556
1557
1558
1559
1559
1560
1561
1562
1563
1564
1565
1566
1567
1568
1569
1569
1570
1571
1572
1573
1574
1575
1576
1577
1578
1579
1579
1580
1581
1582
1583
1584
1585
1586
1587
1588
1589
1589
1590
1591
1592
1593
1594
1595
1596
1597
1598
1598
1599
1599
1600
1601
1602
1603
1604
1605
1606
1607
1608
1609
1609
1610
1611
1612
1613
1614
1615
1616
1617
1618
1619
1619
1620
1621
1622
1623
1624
1625
1626
1627
1628
1629
1629
1630
1631
1632
1633
1634
1635
1636
1637
1638
1639
1639
1640
1641
1642
1643
1644
1645
1646
1647
1648
1649
1649
1650
1651
1652
1653
1654
1655
1656
1657
1658
1659
1659
1660
1661
1662
1663
1664
1665
1666
1667
1668
1669
1669
1670
1671
1672
1673
1674
1675
1676
1677
1678
1679
1679
1680
1681
1682
1683
1684
1685
1686
1687
1688
1689
1689
1690
1691
1692
1693
1694
1695
1696
1697
1698
1698
1699
1699
1700
1701
1702
1703
1704
1705
1706
1707
1708
1709
1709
1710
1711
1712
1713
1714
1715
1716
1717
1718
1719
1719
1720
1721
1722
1723
1724
1725
1726
1727
1728
1729
1729
1730
1731
1732
1733
1734
1735
1736
1737
1738
1739
1739
1740
1741
1742
1743
1744
1745
1746
1747
1748
1749
1749
1750
1751
1752
1753
1754
1755
1756
1757
1758
1759
1759
1760
1761
1762
1763
1764
1765
1766
1767
1768
1769
1769
1770
1771
1772
1773
1774
1775
1776
1777
1778
1779
1779
1780
1781
1782
1783
1784
1785
1786
1787
1788
1789
1789
1790
1791
1792
1793
1794
1795
1796
1797
1798
1798
1799
1799
1800
1801
1802
1803
1804
1805
1806
1807
1808
1809
1809
1810
1811
1812
1813
1814
1815
1816
1817
1818
1819
1819
1820
1821
1822
1823
1824
1825
1826
1827
1828
1829
1829
1830
1831
1832
1833
1834
1835
1836
1837
1838
1839
1839
1840
1841
1842
1843
1844
1845
1846
1847
1848
1849
1849
1850
1851
185

METHOD AND APPARATUS FOR POWER
CONNECTION IN A MODULAR PATIENT CARE SYSTEM

Robert J. Duffy
Lon M. Severe
Edward M. Richards
Shawn W. DeKalb
James P. Stewart

5

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S.

10 Patent Application Serial No. 08/403,503, entitled "Modular Patient Monitoring and Infusion System," filed March 13, 1995 and assigned to the assignee of the present invention. The subject matter of U.S. Patent Application Serial No. 08/403,503 is incorporated herein by reference.

15 This application also contains subject matter related to copending U.S. Pat. App. Ser. No. ____ filed _____ entitled "Method and Apparatus for Logical Addressing in a Modular Patient Care System," both assigned to the assignee of the present invention. The subject matter of this 20 application is also incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates generally to modular patient care systems. More specifically, the present 25 invention relates to modular connection arrangement wherein modules are detachably connected to each other in a convenient, flexible, interchangeable, and secure manner. Additionally, the present invention relates to a scheme for flexibly, bilaterally, and safely providing electrical power 30 from a central management unit to attached peripheral units.

BACKGROUND OF THE INVENTION

Systems containing multiple infusion pumping units, 35 sensing units such as blood pressure monitors and pulse oximeters, and other patient-care units are known in the

medical field. For example, Kerns et al (U.S. Pat. No. 4,756,706; "Kerns") discloses a centrally managed pump system in which pump and monitoring modules are selectively attached to a central management unit. The central management unit 5 controls the internal setup and programming of the attached modules, and receives and displays information from them. Each module is capable of being detached from the central management unit except for the first module, which is permanently attached. Once attached and programmed, a module 10 which is subsequently detached is still capable of operating independently of the management unit.

Kerns provides for attachment of the modules in a vertical stacking sequence in a manner similar to that shown in Figure 1. Attachment of an additional unit to the modular 15 patient care system involves a multiple step process. These steps include (1) sliding a support plate 62 of the additional unit into the channel 64 of a previous unit, and (2) turning a knob 120, causing male connectors 122 and 124 of the additional unit to pop up and mate with corresponding 20 female portions in the previous unit (Kerns Fig. 3 and col. 4 lines 7-16). Thus, achieving mechanical and electrical connectivity in Kerns clearly involves a multi-step, two-handed operation.

Further, Kerns provides for distinct, direct electrical 25 connectivity from each stack module to the central management unit. Each module is provided with a separate AC power signal from the central management unit AC+ and AC- leads. Each module also contains its own power supply for autonomous operation when disconnected from the central management unit 30 (Kerns Fig. 6).

Kerns has several disadvantages. First, for electrical and mechanical connectivity of an added unit to the central management unit, a multi-step, two-handed operation is needed, which may be cumbersome and time consuming in the 35 medical environment. Second, because each module requires its own set of electrical paths to the central unit, the total number of modules which may be stacked is only one

greater than the number of pass-through cables in each module. For example, for the pass-through structure shown in Kerns Fig. 4f, only four modules total may be accommodated by a system which uses these modules. Third, there is added 5 weight, cost, and complexity due to the multiple cabling structure. For example, each signal of each cable must have its own contact pin in among the pins 122 of the contact structure of Kerns Fig. 3. Finally, the presence of a power supply in each functional module adds weight and cost.

10 Rubalcaba (U.S. Pat. No. 4,898,578) also discloses a drug infusion system which includes a plurality of infusion pump modules selectively attached to a central management unit so as to provide for centralized control. In particular, the central management unit obtains infusion 15 parameters from the user and then performs calculations with the parameters to establish the desired infusion rate. Once this rate is determined, the central management unit may control the infusion accordingly. Rubalcaba, however, provides no solution for the problems related to electrical 20 and mechanical connectivity of units described above with respect to Kerns.

Accordingly, it is an object of the present invention to provide a modular patient care system wherein modules are detachably connected to each other in a convenient, flexible, 25 interchangeable, and secure manner.

It is another object of the present invention to provide a modular patient care system wherein each functional unit is powered by the central management unit using a common power bus scheme to avoid a multiplicity of power lines.

30 It is a further object to provide a flexible, bilateral power scheme wherein any functional unit may be placed anywhere in a linear array of units and be adequately powered. It is a further object of the present invention to make this powering scheme safe by avoiding active power 35 supply voltages at exposed ends of the power bus.

SUMMARY OF THE INVENTION

These and other objects of the present invention are provided in a modular patient care system comprising an interface unit for providing a user interface to the system and for providing electrical power to at least one functional unit, the functional unit being capable of removable connection to the interface unit for providing patient therapies or monitoring the condition of the patient, the functional unit being for removable attachment to the interface unit or other functional units so as to form a linear array of units. The linear array of units comprises an originating end and a terminating end, and each unit has an originating side and a terminating side, the originating side of any unit being capable of removable connection to the terminating side of any other unit. In one embodiment, the originating side is the left side, and the terminating side is the right side of the linear array.

The interface unit according to the present invention has a left power lead for powering left side functional units and a right power lead for powering right side functional units. Power supply aspects of the left and right sides are substantially symmetric. Using the left side as an example, power supplying aspects of the interface unit are arranged so as to connect power to the left power lead when functional units are attached to the left, but to leave the left power lead electrically isolated when no functional units are attached to the left. This prevents the unsafe and insecure situation of a live voltage existing at an exposed left power lead of the linear array of units, which would be subject to shorting out or otherwise undesirably discharging. To accomplish this objective, the interface unit includes a power source for receiving electrical power from a power supply and providing electrical power, a detecting lead for detecting the presence of a right sense signal, such as a ground signal, from a unit attached to the left, means for coupling the power source to the left power lead in the

presence of the right sense signal, and means for decoupling the power source from the left power lead in the absence of the right sense signal. In one embodiment, the detecting lead is connected to a gate of a field effect transistor, the 5 power source is connected to a drain of the field effect transistor, and the left power lead is coupled to a source of the field effect transistor.

A flexible, bilateral, and safe powering scheme in the modular patient care system according to the present 10 invention is also provided for by providing an exemplary functional unit having a left lead and a right lead, the left lead for contacting the right lead of a left adjacent functional unit or the right power lead of the left adjacent interface unit in the linear array, the right lead for 15 contacting the left lead of a right adjacent functional unit in the linear array or the right power lead of the right adjacent interface unit in the linear array. The functional unit has a load unidirectionally coupled to the left and right leads and capable of receiving electrical power from 20 either of the leads. The functional unit also has a right sense signal lead for providing a right sense signal to the adjacent right unit, if any, and a left detect lead for detecting the right sense signal from the adjacent left unit, if any. Further, the functional unit also has a left sense 25 signal lead for providing a left sense signal to the adjacent left unit, if any, and a right detect lead for detecting the left sense signal from the adjacent right unit, if any. Finally, the functional unit comprises means for 30 bidirectionally connecting the left power lead to the right power lead only upon detecting both left and right signals.

In this manner, a functional unit which is located between two other units in the linear array is capable of powering its load while also passing power, in either direction as needed, to the adjacent unit which is located 35 farther away from the interface unit. However, if the functional unit is located at the left end of the linear array, the left power lead remains electrically isolated

because no right sense signal is detected. Likewise, if the functional unit is located at the right end of the linear array, the right power lead remains electrically isolated because no left sense signal is detected. In this manner,

5 the functional units are capable of flexible, bilateral power connection in the linear array of units, and live power contacts are prevented from existing at the leads located at the ends of the linear array of units for safety and security.

10 In another embodiment of the invention, a modular patient care system is provided having an interface module for providing a user interface to the system and at least one functional module capable of removable connection to the interface module. The functional module is for providing
15 patient therapies or monitoring the patient's condition and is capable of removable attachment to the interface module or other functional modules so as to form a linear array of modules. The linear array of modules comprises an originating end and a terminating end, and each module has an
20 originating side and a terminating side, the originating side of any module being capable of removable connection to the terminating side of any other module.

Physically, an exemplary functional module according to the present invention comprises a first portion grippable by
25 a user and is configured and dimensioned so as to be capable of being held by a single hand of the user by gripping the first portion. Any pair of modules, including for example the interface module and the exemplary functional module, are easily, flexibly, and interchangeably coupled by including a
30 hinge connector pair for allowing hingeable engagement of the pair, a latch mechanism for securing the pair together, and a guide mechanism located between the hinge connector pair and the latch mechanism for discouraging off-axis engagement of the modules and for providing mechanical stability to the
35 engaged pair. The latch mechanism is designed to automatically secure the pair together, such that engagement of the modules takes place in a single-handed, single step

operation, but is designed to require a manual operation by a hand separate from the hand gripping the first portion to unlatch the modules during disengagement. This provides for increased security and prevention of accidental disengagement 5 of modules. Preferably, the latch mechanism springably couples together such that tactile feedback is provided to the user during attachment. An optional fastener for fastening the latching mechanism together may be included, which requires a special tool for unfastening the latching 10 mechanism so as to further increase system security at the option of the user.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of a multi-module electronic 15 system wherein the individual modules are interconnected electrically and structurally in accordance with the present invention;

FIG. 2 shows an oblique view of two modules showing structural and electrical features for module connection in 20 accordance with the present invention;

FIG. 3a shows a front view of the modules shown in FIG. 2 positioned for subsequent engagement with each other, with portions broken away to reveal the connection scheme according to the present invention and associated electronic 25 components;

FIG. 3b shows the modules of FIG. 3a after engagement;

FIG. 4 shows an exploded perspective view of a single module showing the interconnector parts of the present invention enlarged and out-of-scale;

30 FIG. 5a shows a bottom view of a pair of engaged modules in accordance with an embodiment of the present invention;

FIG. 5b shows a front cut-away view of the modules of FIG. 5a to reveal a latching and locking scheme in accordance with an embodiment of the present invention;

35 FIG. 6 shows a functional diagram of the power provision features of the interface unit according to the present invention;

FIG. 7 discloses a functional circuit diagram of the bilateral powering features of a functional unit in accordance with the present invention; and

FIG. 8 shows a functional diagram of the unit detection 5 and power features of a modular patient care system in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The following embodiments of the present invention will 10 be described in the context of a modular patient care system, although those skilled in the art would recognize that the disclosed methods and structures are readily adaptable for broader application. Note that whenever the same reference numeral is repeated with respect to different figures, it 15 refers to the corresponding structure in each figure.

FIG. 1 discloses a modular patient care system 100 in accordance with the present invention. Modular patient care system 100 comprises a plurality of modules or units, including interface unit 102 and functional units 104, 20 detachably coupled to each other to form a linear array. Shown in FIG. 1 are exemplary functional units 104A, 104B, 104C, and 104D coupled to interface unit 102. While four functional units are shown in FIG. 1, a modular patient care system in accordance with the present invention may comprise 25 interface unit 102 coupled to only a single functional unit 104, or may comprise interface unit 102 coupled to as many as "N" functional units 104.

Interface unit 102 generally performs the functions of (1) providing a physical attachment of the system to 30 structures such as IV poles and bedrails, (2) providing electrical power to the system, (3) providing an interface between the system and external devices, (4) providing a user interface to the system, and (5) providing overall system control, which includes providing information to and 35 receiving information from functional units 104. Shown in FIG. 1 are certain user interface aspects of interface unit

102, which may include an information display 106, numerical hardkeys 108, and softkeys 110.

Functional units 104 are generally for providing patient therapies or monitoring responsive to information, at least 5 some of which may be received from interface unit 102. In many cases, functional units 104 are also for communicating information to interface unit 102. For example, functional unit 104A may be an infusion pump unit for delivering fluids to a patient responsive to certain commands received from 10 interface unit 102, while functional unit 104B may be a blood pressure monitoring unit for providing patient blood pressure information to the interface unit 102. The scope of the invention is not so limited, however.

For the purposes of the present invention, the specific 15 function of each individual functional unit 104 is not critical. Rather, the present invention is directed toward (1) the mechanical and electromechanical coupling of the functional units 104 to each other and to interface unit 102, and (2) the electrical powering scheme of the modular patient 20 care system 100. Thus, for purposes of understanding the present invention, it is important only to recognize that functional units 104 (1) require means for detachably coupling to each other and to interface unit 102, and (2) require electrical power.

25 In a preferred embodiment of the present invention, interface unit 102 and functional units 104 are laterally interchangeable. By laterally interchangeable, it is meant that the modules may be placed in any order in forming a linear array of modules. Thus, in FIG. 1, the modular 30 patient care system 100 may instead have its modules ordered left-to-right in the sequence 104C, 102, 104B, 104D, 104A without affecting its functionality. In order to be laterally interchangeable, the units 102 and 104 of FIG. 1 should have substantially identical interconnection features 35 on their respective left sides, and should have corresponding substantially identical interconnection features on their right sides. If the units were instead for coupling in a

vertical linear array, which is within the scope of the present invention, the interconnection features would have substantially identical interconnection features on their respective top sides, and would have corresponding

5 substantially identical interconnection features on their bottom sides. For clarity of explanation, however, only a left-to-right physical arrangement is described.

To achieve the lateral interchangeability described above, each of the units 102 and 104 should also have power, 10 unit detection, and communication circuitry which is complementary. By complementary, it is meant that the units 102 and 104 generally have power, unit detection, and communications circuit contacts on a first side and on a second side, and that the first side contacts of one unit may 15 be connected to corresponding second side contacts of any other unit, with the overall linear array of units comprising modular patient care system 100 being fully operational. In FIG. 1, for example, the first side of a unit is the left side, and the second side of a unit is the right side.

20 Further to this example, and as further explained later, functional unit 104C must be capable of receiving electrical power from interface unit 102 to its left and transferring it to unit 104D to its right; yet, if physically interchanged with functional unit 104B, unit 104C must be capable of 25 receiving electrical power from interface unit 102 to its right and transferring it to unit 104A to its left, and so on.

As shown in FIG. 1, each functional unit 104 may include a unit ID indicator 112 which identifies a logical address of 30 the functional unit within the linear array. The logical address of a functional unit 104 indicates its position in the linear array relative to other functional units 104. The logical address of a functional unit 104, such as unit 104B, is used by the interface unit 102 to identify and uniquely 35 communicate with functional unit 104B in a common communications bus environment to be described later. In a preferred embodiment of the invention, the logical address of

a functional unit corresponds to its sequential position in the linear array of functional units. Thus, the system shown in FIG. 1 may illustratively contain functional units 104A-104D with logical addresses A, B, C, and D, ordered left to right. In this embodiment, the left side of the leftmost unit forms an originating end of the linear array, while the right side of the rightmost unit forms a terminating end of the linear array.

Referring now to FIGS. 2 through 4, the mechanical and 10 electromechanical aspects of interface unit 102 and functional units 104 as designed in accordance with a first embodiment of the present invention are now described. For purposes of the first embodiment of the present invention, interconnection features of interface unit 102 are 15 substantially identical to interconnection features of functional units 104. Therefore, only an exemplary unit 104A will be described. Also, an exemplary unit 104B, substantially identical to unit 104A and for connecting thereto, will be described when needed for clarity.

20 FIG. 2 shows an oblique representation of exemplary units 104A and 104B positioned before being matingly connected, while FIGS. 3a and 3b show appropriate cut-away views of units 104A and 104B during and after the connection process, respectively.

25 As shown in Fig. 2, unit 104A comprises a chassis 200 having a left side 202, a front 204, and a right side 206. It is to be appreciated that although Fig. 2 shows numbered components on units 104A and 104B according to their visibility in the oblique drawing, the units 104A and 104B 30 contain substantially identical numbered components. Unit 104A further comprises a male connector portion 208 on right side 206, a female connector portion 210 on left side 202, a male elevation feature 212 formed on right side 206, a female recess feature 214 formed in left side 202, a catch feature 35 216 formed near the bottom of right side 206, and a latch 218 near the bottom of left side 202. Unit 104A further comprises cover 220 tethered to male connector portion 208

for covering the male connector portion 208 during periods of non-use, and pocket 222 formed in right side 206 near male connector portion 208 for receiving cover 220 otherwise. Unit 104A further comprises cover 224 tethered to female 5 connector portion 210 for covering female connector portion 210 during periods of non-use, and pocket 226 formed in left side 202 near female connector portion 210 for receiving cover 220 otherwise.

Generally, as shown in FIGS. 3a and 3b, units 104A and 10 104B are designed to be connected using the steps of (1) tilting the units relative to each other while inserting male connector portion 208 into female connector portion 210, (2) swinging down the units to a nearly parallel position such that male elevation feature 212 is received into female 15 recess feature 214 and latch 218 is received into catch feature 216, and (3) pressing the units together such that latch 218 is locked into catch feature 216.

Male connector portion 208 of unit 104A is positioned and formed for hingeable connection with female connector 20 portion 210 of unit 104B for achieving mechanical and electrical coupling of units 104 and 105. In a preferred embodiment of the invention, male connector portion 208 and female connector portion 210 also form a 15-pin electrical connector pair for electrically coupling. This electrical 25 connector pair is for electrically coupling electronic components contained in units 104A and 104B, these electronic components being shown generally as elements 300 in FIGS. 3a and 3b. The geometry of male connector portion 208 and female connector portion 210 include lead-in and chamfer to 30 reduce the probability of dropping and off-axis insertion. Advantageously, the geometry of the male-female pair is designed to prevent a unit from falling off if it is hooked but not yet latched. The mechanical characteristics of the male-female pair are detailed in U.S. Patent Application 35 Serial Number 08/403,502, cross-referenced above.

Male elevation feature 212 is formed on right side 206 of unit 104A for mating with female recess feature 214 formed

in left side 202 of unit 104B to provide multiple contact surfaces for improved front to back stability during vibration of the connected units. Further, the geometry of male elevation feature 212 includes lead-in and chamfer for 5 mechanical guidance into recess feature 214 such that the probability of off-axis insertion is reduced.

Latch 218 is for engaging a catch feature 216 during connection. This keeps the units together mechanically after attachment. In a preferred embodiment, latch 218 is spring 10 loaded with a pre-load force sufficient to positively engage the catch feature 216, close, and remain latched unless disengaged by an operator. Also in a preferred embodiment, techniques known in the art may be used to shape latch 218 and catch feature 216 such that a small vibration resonates 15 through units 104A and 104B upon attachment, to provide tactile feedback to the user.

Cover 220 is for covering male connector portions 208 during transport and periods of non-use. In a preferred embodiment of the invention, cover 220 is made of an 20 elastomeric material which is elastic and waterproof. Cover 220 is tethered to male connector portion 208 to reduce the possibility of being lost or misplaced by the user, and is dimensioned and configured to be swung up and over male hook feature 208 for protection. Pocket 222 is formed in right 25 side 206 beneath male connector portion 208 for receiving cover 220, which nests into pocket 224 when not in use. Cover 220 may be swung up out of pocket 222 to cover male connector portion 208 to protect connector portion 208 from dust or fluids. Similar purpose, material, and 30 configurations apply to cover 224 and pocket 226.

Advantageously, the covers 220 and 224 and pockets 222 and 226 are configured and dimensioned such that the covers recess flush yet are partially compressed when the units 104A and 104B are attached, thus providing additional shock 35 cushioning and preventing rattling during vibration or transport.

In a preferred embodiment of the invention, the size and geometry of unit 104A is generally such that it may be held by a single hand of a user, although the invention is not necessarily so limited. This is generally the same user hand 5 which receives the tactile feedback described above upon unit attachment.

FIG. 4 shows a view of unit 104A exploded to more succinctly show male connector portion 208 and female connector portion 210 with respect to a preferred embodiment 10 of the invention. Specifically, male connector portion 208 comprises electrical contacts 400 contained on a curved lip 404 formed on a body portion 406. Further, female connector portion 210 comprises electrical contacts 408 protruding into an aperture 410 formed in body portion 412. In a preferred 15 embodiment of the invention, the contact geometry and orientation of electrical contacts 400 and 408 may allow a first set of individual electrical contact pairs formed by joining the connectors to make electrical connection prior to a second set of electrical contacts during connection. A 20 result of this geometry and orientation will be that the first set of contacts will also break after the second set of contacts during disconnection. This ensures, for example, that an electrical ground connection between the units may 25 made first during module attachment, creating a path to dissipate electrostatic discharge.

Also in a preferred embodiment of the invention, body portions 406 and 412 are made of a low surface energy/hydrophobic material to shed fluid from exposed surfaces. Also, in a preferred embodiment the electrical 30 contacts 400 and 408 are insert-molded into body portions 406 and 412, which prevents extraneous fluids from accumulating adjacent to electrical connections.

FIGS. 5A and 5B show units 104A and 104B with additional features in accordance with a preferred embodiment of the 35 invention. FIG. 5A shows a bottom view of coupled units 104A and 104B. Unit 104B comprises latch 218 for engaging catch feature 216 of unit 104A. In this embodiment however, a

fastener 500 may be employed to provide a means for making the attachment of units 104A and 104B permanent until the fastener 500 is released by a user using a releasing technique. This releasing technique may employ the use of a 5 special tool (not shown) made available only to specified users. FIG. 5B shows a side view of latch 218 engaged to catch feature 216, further showing a latch tongue 502 of latch 218 which forms a hole 504 in an area which overlaps catch feature 216. Fastener 500 which is, for example, a 10 screw, is inserted from the bottom of functional unit 104A near catch feature 216 through hole 504 and into a boss 506 contained in functional unit 104A near catch feature 216. The configuration shown advantageously provides for permanent attachment of the units until a user such as a medical 15 technician disengages fastener 500. In this manner, for example, miscellaneous persons around and in the area of the modular patient care system 100 are prevented either from intentionally or accidentally causing disconnection of units.

The unique combination of the module elements described 20 thus far provide for many advantages in stability, safety, security, and ease of use. For example, the attachment of a functional unit may be achieved in a one hand, single step operation, while the presence of latch 218 and catch feature 216 dictate that detachment must take place in a two step 25 operation. This is advantageous in a medical environment where quick, easy attachment of units to the linear array may be necessary, but where detachment of units should be permissible only upon an explicit, reasoned desire of a user and not by accident. This feature is enhanced an a preferred 30 embodiment of the invention employing a fastener 500, wherein further steps are needed to detach modules.

Further, the ease of the one-handed, single step operation in the attachment of units is enhanced where latch 218 and catch feature 216 provide for tactile feedback during 35 the attachment operation. This is advantageous in the medical environment by freeing up the eyes of the user during attachment to pay attention to more sensitive events taking

place, such as insuring that needles, lines, fluids, or pumps are not being disturbed during the mechanical movement. Further, the avoidance of the need for visual feedback to the user may save precious moments during medical emergencies 5 when the user's eyes are more advantageously averted to the emergency at hand.

Even further, the presence of male elevation feature 212 mated to recess feature 214 provides for additional front to back stability of the units during handling and abuse. These 10 features also provide guidance during connection to prevent off-axis insertion. Vibration of coupled units is further reduced by the compression of covers 220 and 224 against each other and pockets 222 and 226.

Even further, several means exist to protect the 15 electrical connections from fluid ingress when units are not connected. First, the contact geometry, contact orientation, and hook geometry as shown in FIG. 4 prevent fluid from accumulating on surfaces of the male connector portion 208. Similarly, the contact geometry, contact orientation, and 20 contact location of the electrical contacts 408 prevent fluid from accumulating on surfaces of the female connector portion 210. Use of low surface energy/hydrophobic material for body portions 406 and 412, insert-molding of the contacts 400 and 408, and the presence of covers 220 and 224 further 25 discourage unwanted fluid accumulation and ingress.

In the modular patient care system 100 of FIG. 1, electrical power is supplied to functional modules 104 by interface unit 102. The interface unit 102, in turn, may be powered by conventional methods known in the art. At least 30 one electrical power path exists among the electrical contacts 408 and 400 at the connecting point of any two units.

The goal of a module powering system designed in accordance with the present invention is, first, for 35 interface unit 102 to provide power to any attached module or set of modules by powering immediately adjacent modules. Thus, in FIG. 1, interface unit 102 is to supply electrical

power to all functional units 104 by powering functional units 104B and 104C, which each use a portion of this power and which, in turn, transfer at least a portion of this power further down the line to units 104A and 104D, respectively.

5 Second, the module powering system in accordance with the present invention is to permit lateral interchangeability of the modules, and thus the powering system of any functional unit 104 is to be bilateral. By bilateral, it is meant that the functional unit 104 may receive power from 10 either its first or second side, and may transmit this power, if necessary, to attached units on its second or first side, respectively.

Third, it has been found that a module powering system according to the present invention is to comprise an 15 interface unit 102 and functional units 104 which, if they are positioned on the originating or terminating end of a linear array, do not allow a live voltage to exist at the open electrical contacts which will exist at these ends. Such a requirement provides, for example, for added security 20 of the unit from power failure due to accidental or intentional shorting of the exposed power leads.

Turning now to FIGS. 6 through 8, a module powering system according to a second embodiment of the present invention is described. FIG. 6 shows a functional diagram of 25 the power aspects of interface unit 102 designed in accordance with the present invention. Interface unit 102 comprises a microprocessor 600, a power source 602, a left transistor 604, and a right transistor 606. Power source 602 is adapted for providing an 8-volt DC voltage by either 30 generating its own power, as from a DC voltage source such as an internal battery, or for adapting power from an external AC or DC source, as is known in the art. The 8 volts DC provided by power source 602 is provided by lead 607 with respect to the ground plane of interface unit 102, denoted 35 generally by element 608 in FIG. 6. Interface unit 102 further comprises left and right power leads 610 and 612, respectively, for coupling to and providing power to left and

right adjacent functional units, respectively, when connected. Power leads 610 and/or 612 will be left open, however, when adjacent units are not connected. Interface unit 102 further comprises left and right module detect leads 5 614 and 616, respectively, for detecting the presence of attached functional units on the left and right sides, respectively. Interface unit 102 further comprises ground leads 618 to 620 for providing left and right sense signals, respectively (which in this embodiment are ground signals) to 10 adjacently attached units. It is noted that additional electrical contacts not shown may provide an overall ground plane signal to attached functional units, as is known in the art.

As shown in FIG. 6, lead 607 of power source 602 is 15 coupled to the source of left transistor 604 and also to the source of right transistor 606. In the embodiment shown, transistors 604 and 606 are, in this embodiment, P-channel enhancement MOSFETs. The gate of left transistor 604 is coupled to left module detect lead 614, while the gate of 20 right transistor 606 is coupled to right module detect lead 616. Finally, the drain of left transistor 604 is coupled to left power lead 610, while the drain of right transistor 606 is coupled to right power lead 612.

As shown in FIG. 6, transistor 604 will conduct (i.e., 25 create a "short" between its drain and source) when its gate is low with respect to the source, and will not conduct (i.e., create an "open") when its gate is high. Transistor 606 behaves similarly. Thus, if left module detect lead 614 is grounded by attachment to an external signal, such as a 30 signal provided by an attached functional unit to the left, transistor 604 will conduct, and thus power lead 610 will be coupled to power source lead 607 to provide power. When left module detect lead 614 is left open, as when a unit is not attached to the left, transistor 604 does not conduct and 35 leaves power lead 610 electrically isolated from power source lead 607. This, of course, is a desired result. Similar

characteristics exist for right module detect lead 616, transistor 606, and right power lead 612.

It is noted that the coupling of the left module detect lead 614 to microprocessor 600 at pin MODDETL shown in FIG. 6 5 does not affect the powering aspects described here, as pin MODDETL is only for detection purposes of the microprocessor for purposes to be described later. A similar note applies to right module detect lead 616 and pin MODDETR of microprocessor 600. Finally, it is noted that Schottky 10 diodes 626 and 628 are provided across the drain and source of transistors 604 and 606, respectively, for protection against reverse voltages, as is known in the art.

FIG. 7 shows a functional diagram of the power aspects of an exemplary functional unit 104A designed in accordance 15 with the present invention. Functional unit 104A comprises a microprocessor 700 and a load 702 such as an infusion pump motor. It is noted that load 702 may represent any kind of electrical system requiring power, however. Functional unit 104A further comprises a left transistor 704 and a right 20 transistor 706. Load 702 receives electrical power provided between an input node 707 and a ground plane, generally denoted by element 708 in FIG. 7. Functional unit 104A further comprises a left power lead 710, a right power lead 712, a left module detect lead 714, a right module detect 25 lead 716, a left ground lead 718, and a right ground lead 720.

As shown in FIG. 7, the drain of left transistor 704 is coupled to the drain of right transistor 706. Transistors 704 and 706 are, in this embodiment, P-channel enhancement 30 MOSFETS. The source of left transistor 704 is coupled to left power lead 710, while the source of right transistor 706 is coupled to right power lead 712. Left power lead 710 is also coupled through a resistor 722 to the left module detect lead 714, which is in turn coupled directly to the gate of 35 right transistor 706. Correspondingly, right power lead 712 is coupled through a resistor 724 to the right module detect lead 716, which is in turn coupled directly to the gate of

left transistor 704. Left power lead 710 is coupled to the cathode of a diode 726 whose anode is in turn coupled to input node 707 of load 702. Likewise, right power lead 712 is coupled to the cathode of a diode 728 whose anode is in 5 turn coupled to the input node 707 of load 702. - In this manner, if a positive power voltage is present at lead 710, power is supplied to load 702 without being supplied to lead 712 unless both transistors 704 and 706 are conductive. Likewise, if a positive power voltage is present at lead 712, 10 power is supplied to load 702 without being supplied to lead 710 unless both transistors 704 and 706 are conductive.

As shown in FIG. 7, transistor 704 will conduct (i.e., create a "short" between its drain and source) when its gate is low with respect to the source, and will not conduct 15 (i.e., create an "open") when its gate is high. Transistor 706 behaves similarly. The gate of transistor 704 will be forced low when right module detect lead 716 is grounded by an adjacent attached unit to the right. Correspondingly, the gate of transistor 706 will be forced low when left detect 20 lead 714 is grounded by an adjacent attached unit to the left. It is noted that Schottky diodes 730 and 732 are provided across the drain and source of transistors 704 and 706, respectively, for protection against reverse voltages, as is known in the art. It is noted that, as described above 25 and as shown in FIG. 7, module 104A forms a laterally symmetric powering arrangement.

As described herein, a modular patient care system 100 comprising the interface unit of FIG. 6 and functional modules according to FIG. 7 advantageously provides for 30 bilateral power sourcing and transfer through the functional modules 104, while providing electrical isolation of power leads of units at the originating and terminating ends, respectively.

FIG. 8 shows the modules of FIG. 6 and FIG. 7 arranged 35 in an exemplary arrangement comprising functional unit 104A at the originating (left) end, functional unit 104D at the terminating (right) end, and units 104B, 102, and 104C in the

middle, respectively. As shown in FIG. 8, the electrical leads between units are arranged according to the following simple scheme. Left power leads (610 or 710) are coupled to right power leads (712 or 612) in any pair of adjacent units.

5 Left module detect leads (714 or 614) are coupled to right ground leads (620 or 720) in any pair of adjacent units. Finally, left ground leads (618 or 718) are coupled to right module detect leads (716 or 616) in any pair of adjacent units.

10 Serving as an example of a system according to the present embodiment of the present invention, the powering configuration of the modular patient care system 100 shown in FIG. 8 advantageously functions as follows.

Looking to the left of interface unit 102, lead 720 of unit 104B grounds the gate of left transistor 704 of unit 102 via module detect lead 614. Transistor 604 is turned on, and power is thus supplied through left power lead 610 of unit 102 to right power lead 712 of unit 104B, thus powering the load 702 of unit 104B. Left ground lead 618 of unit 102 grounds the gate of left transistor 704 of unit 104B through right module detect lead 716, making transistor 704 conductive. Further, right ground lead 720 of unit 104A grounds the gate of right transistor 706 of unit 104B, making transistor 706 conductive. The result is that both of

25 transistors 704 and 706 of unit 104B are conductive, and thus power lead 712 of unit 104A will receive power from left power lead 710 of unit 104B. Therefore, load 702 of unit 104A will be powered, and thus left side units 104A and 104B are fully powered.

30 However, there is no ground signal provided to left module detect lead 714 of unit 104A because it is the leftmost unit. Thus, right transistor 706 of unit 104A remains turned off. The result is that left power lead 710 of leftmost unit 104A is electrically isolated from right power lead 712, which is the desired result. It should be clear to anyone of ordinary skill on the art, given the lateral symmetry of the powering arrangement described above,

that right side units 104C and 104D operate in a similar but reflexive fashion to the left side units 104A and 104B. Thus, power is provided to both units 104C and 104D, but right power lead 712 of rightmost unit 104D remains 5 electrically isolated from a power source. This, of course, is the desired result.

Additionally, it should be clear to anyone of ordinary skill in the art that the units 102 and 104A through 104D can be arranged in any order in FIG. 8 with the desired result of 10 (1) powering of all units, (2) electrical isolation of the left power leads 710 or 610 of the leftmost (originating) unit, and (3) electrical isolation of the right power leads 712 or 612 of the rightmost (terminating) unit.

Various embodiments of the invention have been 15 described. The descriptions are intended to be illustrative, not limitative. Thus, it will be apparent to those skilled in the art that modifications may be made to the invention as described without departing from the scope of the claims set out below.

20

25

30

35

What is claimed is:

1. A modular patient care system having a plurality of units, said plurality of units comprising:
 - 5 an interface unit for providing a user interface to said system and for providing electrical power to said system; and a functional unit capable of removable connection to said interface unit, said functional unit being capable of providing patient therapies or monitoring, said functional
 - 10 unit comprising a first lead, means for providing a first signal when connected to an adjacent unit, and a load coupled to said first lead for receiving electrical power therefrom; wherein said interface unit comprises:
 - 15 a power source for receiving electrical power from a power supply and providing electrical power to said patient care system;
 - 20 a power lead for electrically contacting said first lead, said power lead having an active state when electrically coupled to said power source, said power lead having an inactive state when electrically isolated from said power source;
 - 25 detecting means for detecting said first signal; coupling means for electrically coupling said power lead to said power source responsive to the presence of said first signal;
 - 30 wherein said power lead is in the active state when said functional unit is connected to said interface unit for supplying electrical power to said functional unit, and wherein said power lead is in the inactive state when said functional unit is not connected to said interface unit.
2. A modular patient care system, comprising:
 - an interface unit for providing a user interface to said system and for providing electrical power to said system,
 - 35 said interface unit comprising a power lead; and a plurality of functional units for providing patient therapies or monitoring, said plurality of functional units

including a first functional unit and a second functional unit, said first functional unit being capable of removable connection to said interface unit, said second functional unit being capable of removable connection to said first 5 functional unit and having a first lead, said second functional unit further comprising means for providing a first signal to said first functional unit when connected thereto and a load coupled to said first lead for receiving electrical power therefrom;

10 wherein said first functional unit further comprises:

15 a first lead configured and dimensioned to contact said power lead of said interface unit when said first functional unit is connected to said interface unit;

20 a second lead for electrically contacting said first lead of said second functional unit;

25 a load coupled to said first lead for receiving electrical power therefrom;

30 detecting means for detecting said first signal from said second functional unit;

35 means for permitting an electrical coupling of said second lead to said first lead of said first functional unit responsive to said first signal from said second functional unit and for electrically isolating said second lead from said first lead of said first functional unit in the absence of said first signal from said second functional unit;

40 whereby said second lead is permitted to be electrically coupled to said power lead of said interface unit when said second functional unit is connected to said first functional unit, and electrically isolated from said power lead when said second functional unit is disconnected from said first functional unit.

3. The modular patient care system of claim 1, said 35 interface unit having an originating side and a terminating side, further comprising an array of functional units each having an originating side and a terminating side, wherein

the originating side of any unit is capable of connection to the terminating side of any other unit,

whereby a linear array of units having an originating end and a terminating end is capable of being formed.

5

4. The modular patient care system of claim 3,
wherein said first signal is an originating side sense signal for indicating the presence of said functional unit to a unit adjacent said originating side in the linear array;
10 wherein said first lead of said functional unit is an originating side lead,

wherein said power lead is a terminating side power lead for contacting an originating side lead of a functional unit adjacent said terminating side of said interface unit,

15 and

wherein said detecting means is a terminating side detecting means for detecting an originating side sense signal from the functional unit in the linear array adjacent said terminating side of the interface unit,

20 whereby when said functional unit is connected adjacent to the terminating side of said interface unit, said terminating side power lead is in the active state, and

whereby said terminating side power lead is inactive when no functional unit is connected adjacent to the
25 terminating side of said interface unit.

5. The modular patient care system of claim 4, said functional unit further comprising a terminating side lead, said load also being coupled to said terminating side lead
30 and being capable of receiving electrical power therefrom, said functional unit further comprising a means for providing a terminating side sense signal to a unit adjacent said terminating side when connected thereto, said interface unit further comprising:

35 an originating side power lead for contacting a terminating side lead of a functional unit adjacent said originating side;

an originating side detect means for detecting a terminating side sense signal from a functional unit adjacent said originating side; and

5 an originating side coupling means for electrically coupling said originating side power lead to said power source responsive to the presence of said terminating side sense signal;

whereby when said functional unit is connected to the originating side of said interface unit, said originating 10 side power lead is electrically coupled to said power source, and

whereby said originating side power lead is electrically isolated when no functional unit is connected to the originating side of said interface unit.

15 6. The modular patient care system of claim 5, said interface unit further comprising:

an originating side sense signal providing means for providing an originating side sense signal to a 20 functional unit adjacent said originating side; and

a terminating side sense signal providing means for providing a terminating side sense signal to a functional unit adjacent said terminating side.

25 7. The modular patient care system of claim 4, said terminating side detection means comprising a lead designed and configured to contact said originating side sense signal providing means of said functional unit adjacent said terminating side upon attachment.

30 8. The modular patient care system of claim 7, said terminating side coupling means comprising a transistor having a first terminal coupled to said power source, a second terminal coupled to said terminating side power lead, 35 and a third terminal coupled to said terminating side detection means lead.

9. The modular patient care system of claim 8, said transistor being a MOSFET, said first terminal being the source of said MOSFET, said second terminal being the drain of said MOSFET, and said third terminal being the gate of 5 said MOSFET.

10. The modular patient care system of claim 8, said functional unit further comprising a terminating side lead, said load also coupled to said terminating side lead and 10 being capable of receiving electrical power therefrom, said functional unit further comprising a means for providing a terminating side sense signal to a unit adjacent said terminating side when connected thereto, said interface unit further comprising:

15 an originating side power lead for contacting a terminating side lead of a functional unit adjacent said originating side;

an originating side detecting means for detecting a terminating side sense signal from the functional unit 20 adjacent said originating side; and

originating side coupling means for electrically coupling said originating side power lead to said power source responsive to the presence of said terminating side sense signal;

25 whereby when said functional unit is connected to the originating side of said interface unit, said originating side power lead is electrically coupled to said power source, and

whereby said originating side power lead is electrically 30 isolated when no functional unit is connected to the originating side of said interface unit.

11. The modular patient care system of claim 10, said originating side detection means comprising a lead designed 35 and configured to contact the terminating side sense signal providing means of the functional unit adjacent said

originating side upon attachment of the functional unit to the originating side of said interface unit.

12. The modular patient care system of claim 11, said 5 originating side coupling means comprising a transistor having a first terminal coupled to said power source, a second terminal coupled to said originating side power lead, and a third terminal coupled to said originating side detection means lead.

10

13. The modular patient care system of claim 6, said originating side and terminating side sense signals being ground signals.

15 14. A modular patient care system having a plurality of units including an interface unit for providing a user interface to said system and for providing electrical power to said system, said plurality of units also including a plurality of functional units for providing patient therapies 20 or monitoring, said interface unit comprising:

a left side, a left lead coupled to said left side, and a left signal providing means at said left side;

a right side, a right lead coupled to said right side, and a right signal providing means at said right side;

25

a power source;

means for coupling said left lead to said power source responsive to a right signal from an attached adjacent left functional unit; and

30

means for coupling said right lead to said power source responsive to a left signal from an attached adjacent right functional unit;

wherein each functional unit comprises:

35

a left side and a right side, said left side being capable of coupling to the right side of any other unit, whereby said interface unit and functional units are

capable of being arranged in a linear array of units having a leftmost unit and a rightmost unit;

5 a left lead at left side and a right lead at said right side, said left lead for coupling to the right lead of an adjacent left unit, said right lead for coupling to the left lead of an adjacent right unit;

10 a load coupled to said left lead through a left one-way power means and capable of receiving electrical power therefrom, said load also being coupled to said right lead through a right one-way power means and capable of receiving electrical power therefrom;

15 a left signal providing means for providing a left signal to an adjacent left unit;

20 a right signal providing means for providing a right signal to an adjacent right unit;

a left detecting means for detecting the right signal of an adjacent left unit;

a right detecting means for detecting the left signal of an adjacent right unit; and

25 20 means for coupling said left lead to said right lead responsive to the presence of the combination of a left signal from a right adjacent unit and a right signal from a left adjacent unit in the linear array;

whereby said loads of each functional unit in the linear array are electrically coupled to said power source,

whereby said left lead of said leftmost unit of said linear array is electrically isolated from said power source, and

30 whereby said right lead of said rightmost unit is electrically isolated from said power source.

15. The modular patient care system of claim 14, said left detection means comprising a lead configured and dimensioned to connect to a right signal providing means of 35 an adjacent left unit when connected, said right detection means comprising a lead configured and dimensioned to connect

to a left signal providing means of an adjacent right unit when connected.

16. The modular patient care system of claim 15, said 5 means for coupling said left lead to said right lead comprising:

a left transistor having a first terminal coupled to said left lead, a second terminal, and a third terminal coupled to said right detection means;

10 a right transistor having a first terminal coupled to said right lead, a second terminal coupled to said second terminal of said left transistor, and a third terminal coupled to said left detection means.

15 17. The modular patient care system of claim 15, wherein said left one-way power means comprises a first diode connected between said left lead and an input of said load, and wherein said right one-way power means comprised a second diode connected between said right lead and said input of 20 said load.

18. The modular patient care system of claim 16, wherein said left and right transistors are MOSFETs, the third terminal of said left MOSFET transistor being its gate 25 terminal, the third terminal of said right MOSFET transistor being its gate terminal.

19. A modular patient care system, comprising:

a plurality of modules including a first module and a 30 second module, said second module comprising a first portion grippable by a user, said second module being configured and dimensioned so as to be capable of being held by a single hand of the user by gripping said first portion;

a hinge connector pair configured and dimensioned to 35 allow hingeable engagement of said second module to said first module near a first end of said second module;

40 a latch mechanism for securing said second module to said first module near a second end of said second module, said latch mechanism comprising a first part connected to said first module and a second part connected to said second 5 module near said second end, said second part being capable of springably securing to said first part when forced into said first part;

means for releasing said second part from said first part;

10 a guide mechanism separate from said hinge connector pair and said latch mechanism and located therebetween, said guide mechanism for discouraging off-axis engagement of said first and second modules and for providing mechanical stability for said first and second modules when engaged;

15 wherein

said means for releasing is located sufficiently distal from said first portion of said second module such that a second hand is required to actuate said releasing means when the first hand of the user is gripping said first portion;

20 whereby

said second module is capable of being structurally engaged to said first module in a one-handed, single step operation, and whereby an at least two-step or two-handed operation is required to structurally disengage said second 25 module from said first module.

20. The modular patient care system of claim 19, said latch mechanism further comprising a latch tongue on one of said first or second parts and a catch feature on the other of 30 said first or second parts for catching and engaging said latch tongue, wherein said releasing means is configured and dimensioned to release said latch tongue from said catch feature upon actuation.

35 21. The modular patient care system of claim 19, said hinge connector pair comprising:

a male hinge connector on either of said first or second modules, said male hinge connector having a first and second set of electrical contacts formed thereon; and

5 a female hinge connector on the other of said first or second modules for hingeably engaging said male hinge connector, said female hinge connector having a third and fourth set of electrical contacts formed thereon configured and dimensioned to connect to said first and second set of electrical contacts, respectively, upon hingeable engagement 10 of said hinge connector pair;

whereby said first and second modules become electrically engaged upon becoming structurally engaged.

22. The modular patient care system of claim 21, wherein 15 said electrical contacts are configured and dimensioned such that said first and third sets of electrical contacts connect before said second and fourth sets of electrical contacts connect during engagement of said first and second modules, and such that said first and third sets of electrical 20 contacts disconnect after said second and fourth sets of electrical contacts disconnect during disengagement of said first and second modules.

23. The modular patient care system of claim 20, further 25 comprising a fastener for affixing said latch tongue within said catch feature, said fastener being configured and dimensioned such that a special fastener tool is required to release said fastener from said latch tongue,

whereby when said fastener has affixed said latch 30 tongue, said first and second modules remain permanently engaged until said fastener is released from said latch tongue using said special fastener tool.

24. The modular patient care system of claim 19, said 35 modules each having a front, a back, and sides, said first and second modules defining a pair when engaged, said guide mechanism comprising:

a male elevation feature protruding from one of said first or second modules;

a female recess feature in the other of said first or second modules;

5 wherein said male elevation feature is chamfered and said female recess feature is shaped for corresponding lead-in to provide guidance of said modules during engagement.

25. The modular patient care system of claim 20, said latch
10 tongue and said catch feature being configured and dimensioned to provide for springable engagement of said latch tongue into said catch feature sufficient to cause a mechanical resonance at said first portion detectable by the user, whereby tactile feedback is provided to the user upon
15 completion of the engagement of said first and second modules.

26. The modular patient care system of claim 21, said first and second modules defining a pair when engaged, said modular
20 patient care system further comprising a cover coupled to said male or female hinge connectors for covering said connector when not in use, said cover being hingeably adjustable with respect to said connector, wherein said cover is configured and dimensioned to be partially compressed upon
25 engagement of said first and second modules to provide cushion and prevent rattling of said pair.

27. The modular patient care system of claim 21, said first module being a main interface module for providing an
30 interface between the system and the user, said second module being a functional module for providing patient therapies or monitoring, said first and second modules each comprising a face, a first surface, and a second surface opposite said first surface,
35 wherein said hinge connector pair, said latch mechanism, and said guide means are formed at said second surface of

100
said first module and said first surface of said second
module, and

wherein said second surface of said second module is
substantially identical to said first surface of said first
5 module;

whereby said first and second modules are capable of
being electrically and structurally engaged by hingeably
coupling said first surface of said second module to said
second surface of said first module, and

10 whereby said first and second modules are also capable
of being electrically and structurally engaged by hingeably
coupling said second surface of said second module to said
first surface of said first module.

15

20

25

30

35

ABSTRACT

A modular patient care system having a central management unit module and one or more detachable functional units is described. Using unique mechanical and electrical 5 features, the modular patient care system is capable of flexibly, bilaterally, and safely providing electrical power from the central management unit to the attached functional units, with exposed power leads of end units being electrically isolated for safety and security. Functional 10 units are capable of detecting the presence of other functional units more distant from the central management unit for passing power to those units, and for otherwise electrically isolating exposed power leads when no further units are attached. Additionally, the modular patient care 15 system provides for a modular connection arrangement wherein modules are detachably connected to each other in a convenient, flexible, interchangeable, and secure manner by providing a hinge connector pair, a specially located latch mechanism, and a guide means between any pair of modules.

20

25

30

35

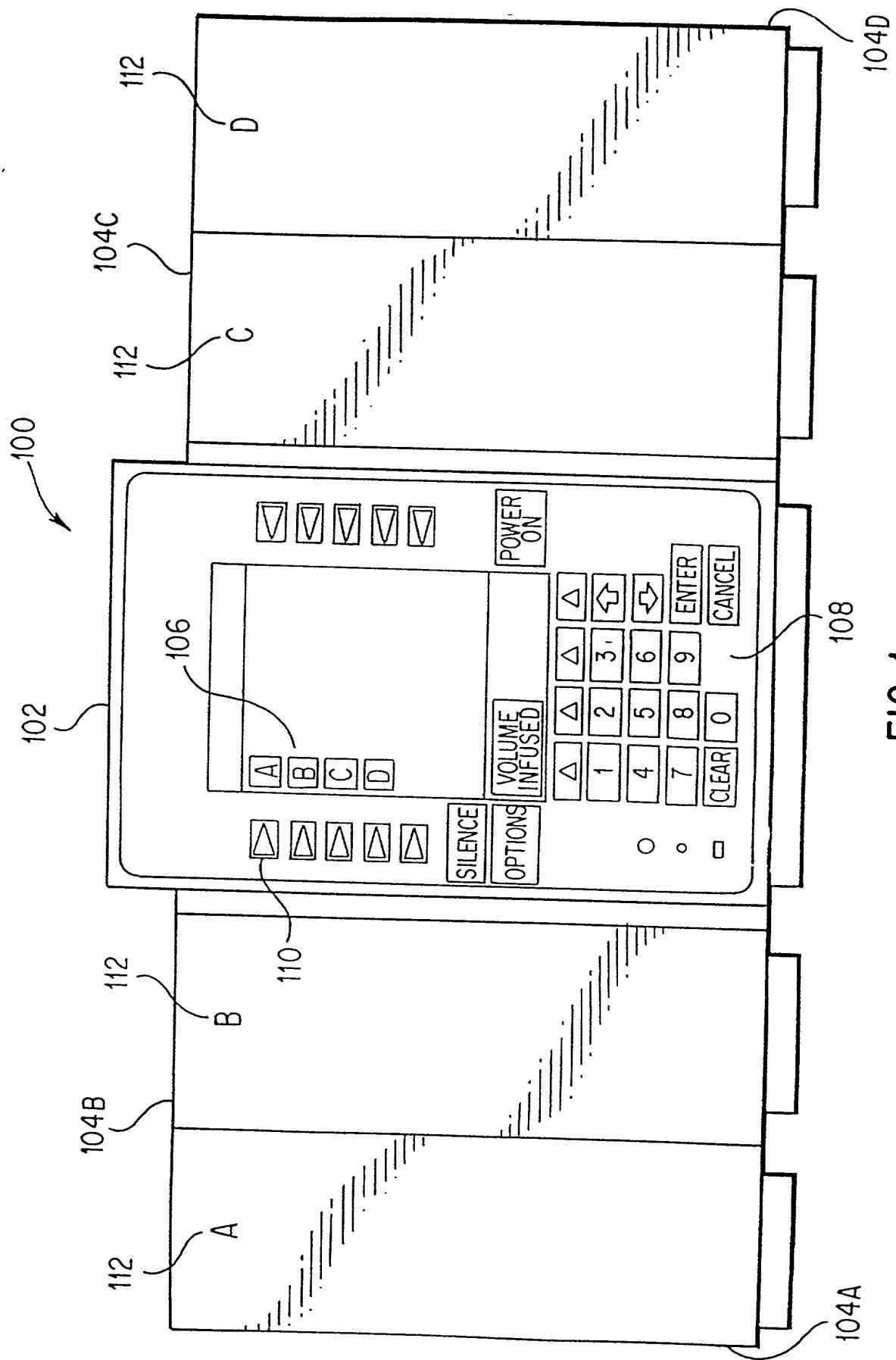


FIG. 1

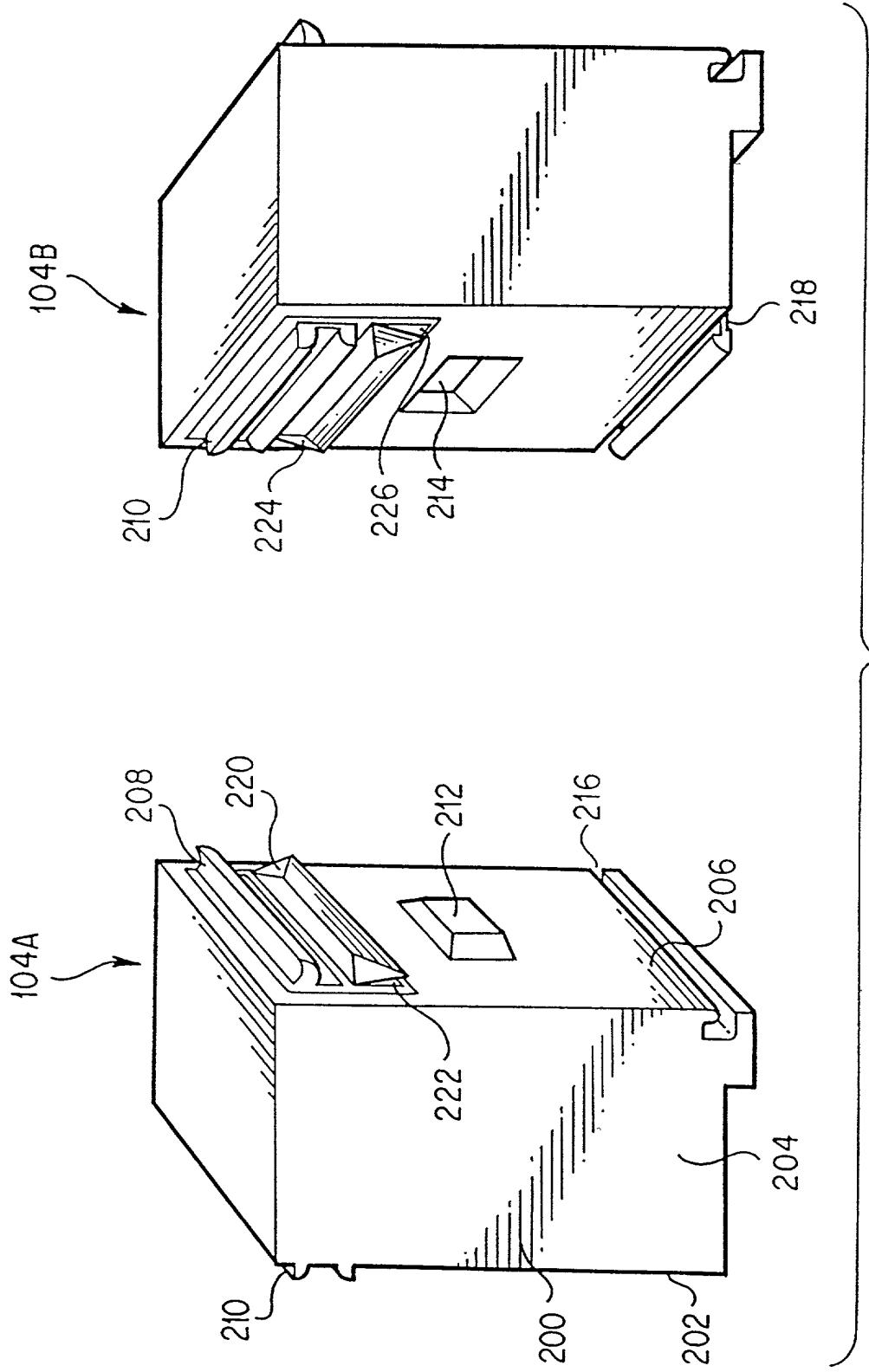


FIG. 2

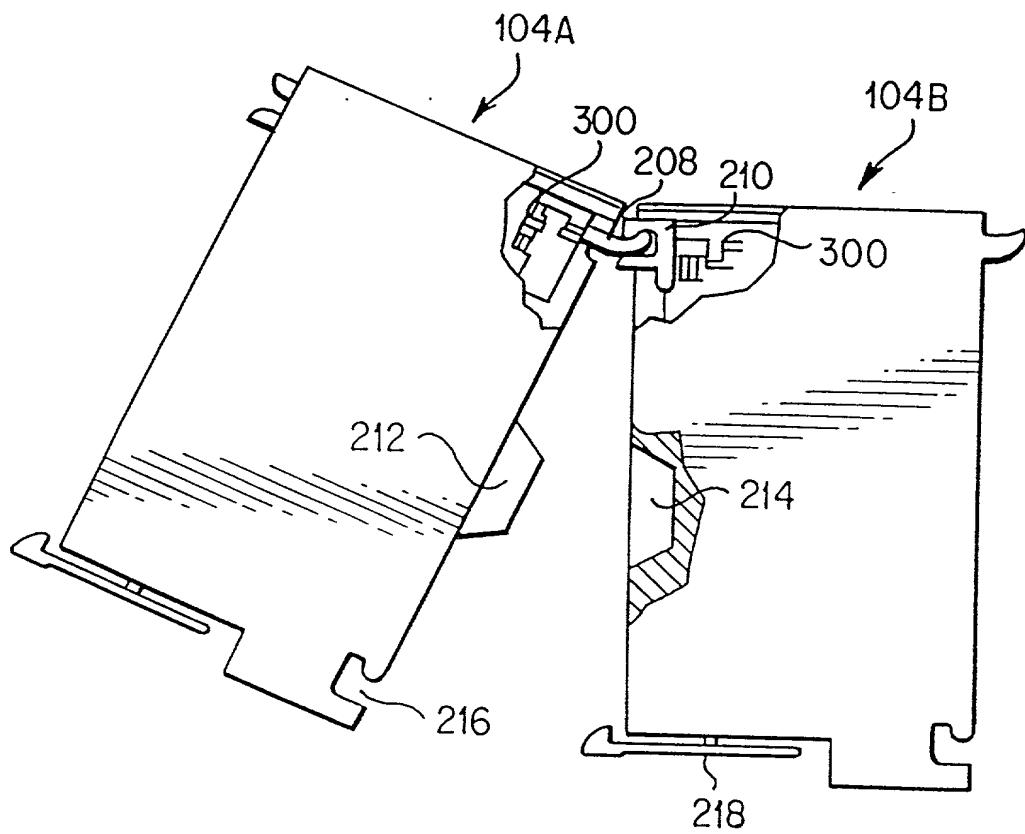


FIG. 3A

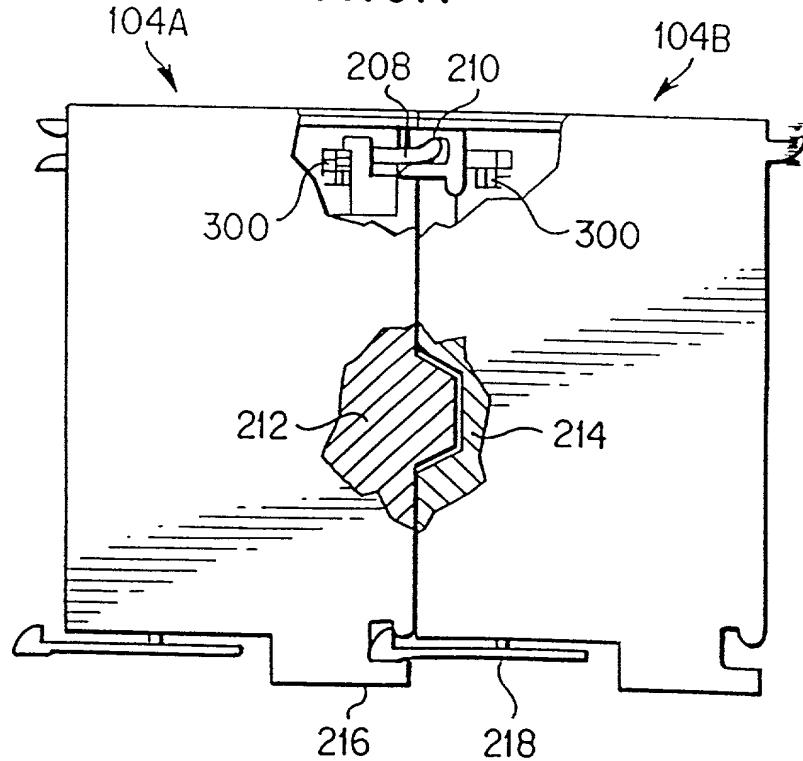


FIG. 3B

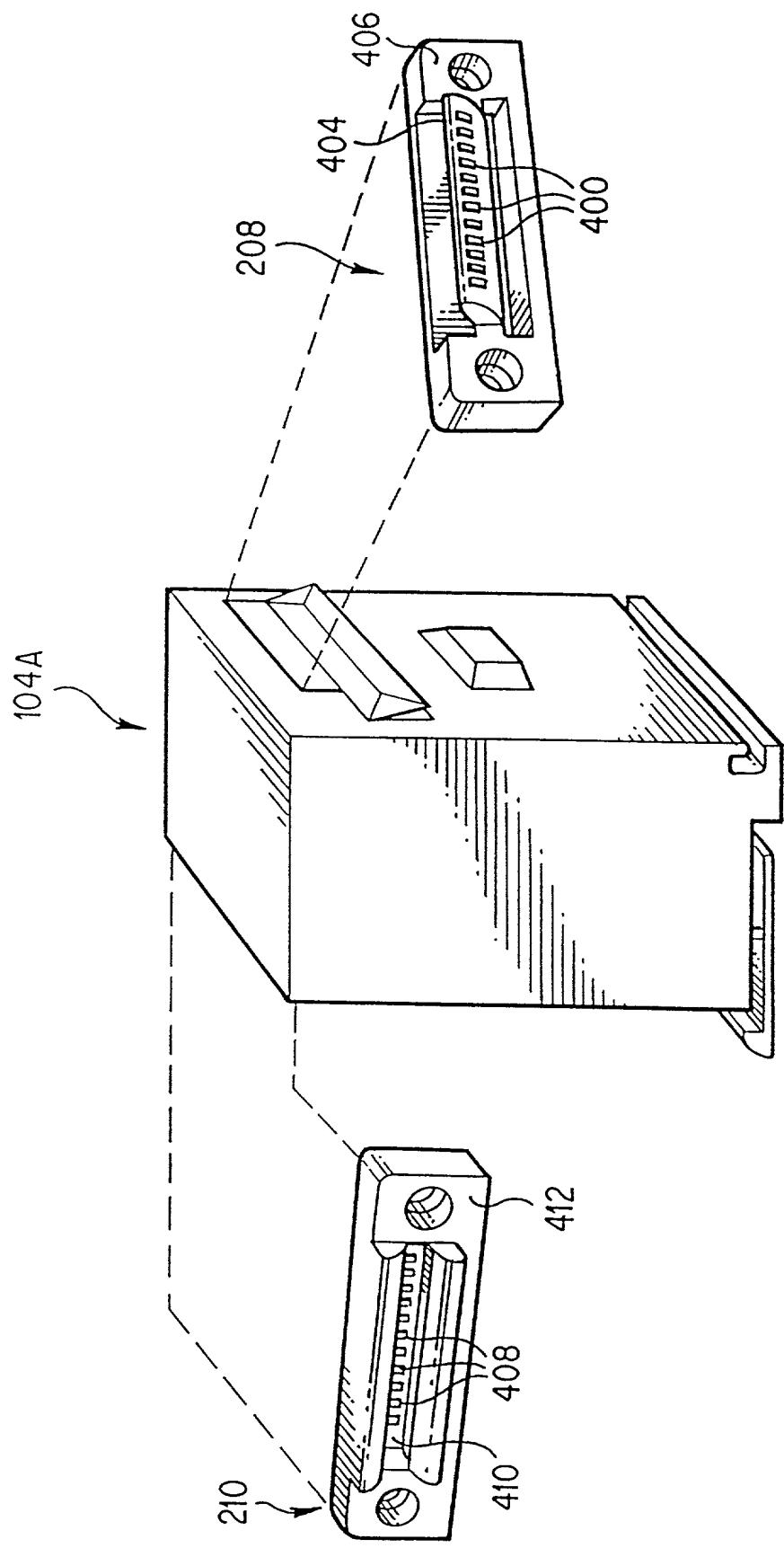


FIG. 4

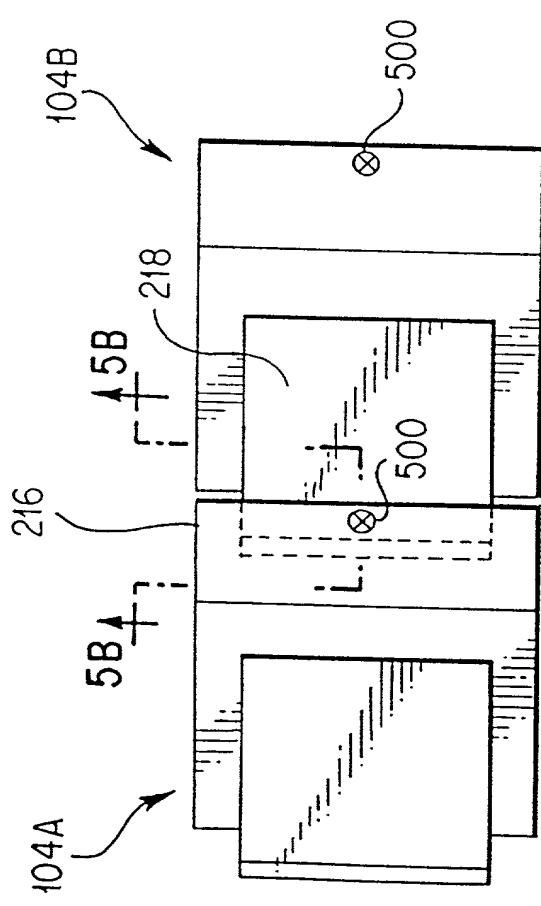


FIG. 5A

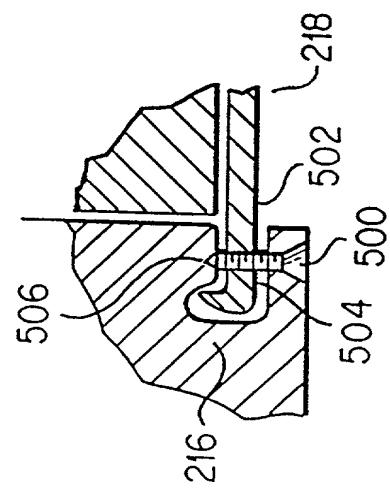


FIG. 5B

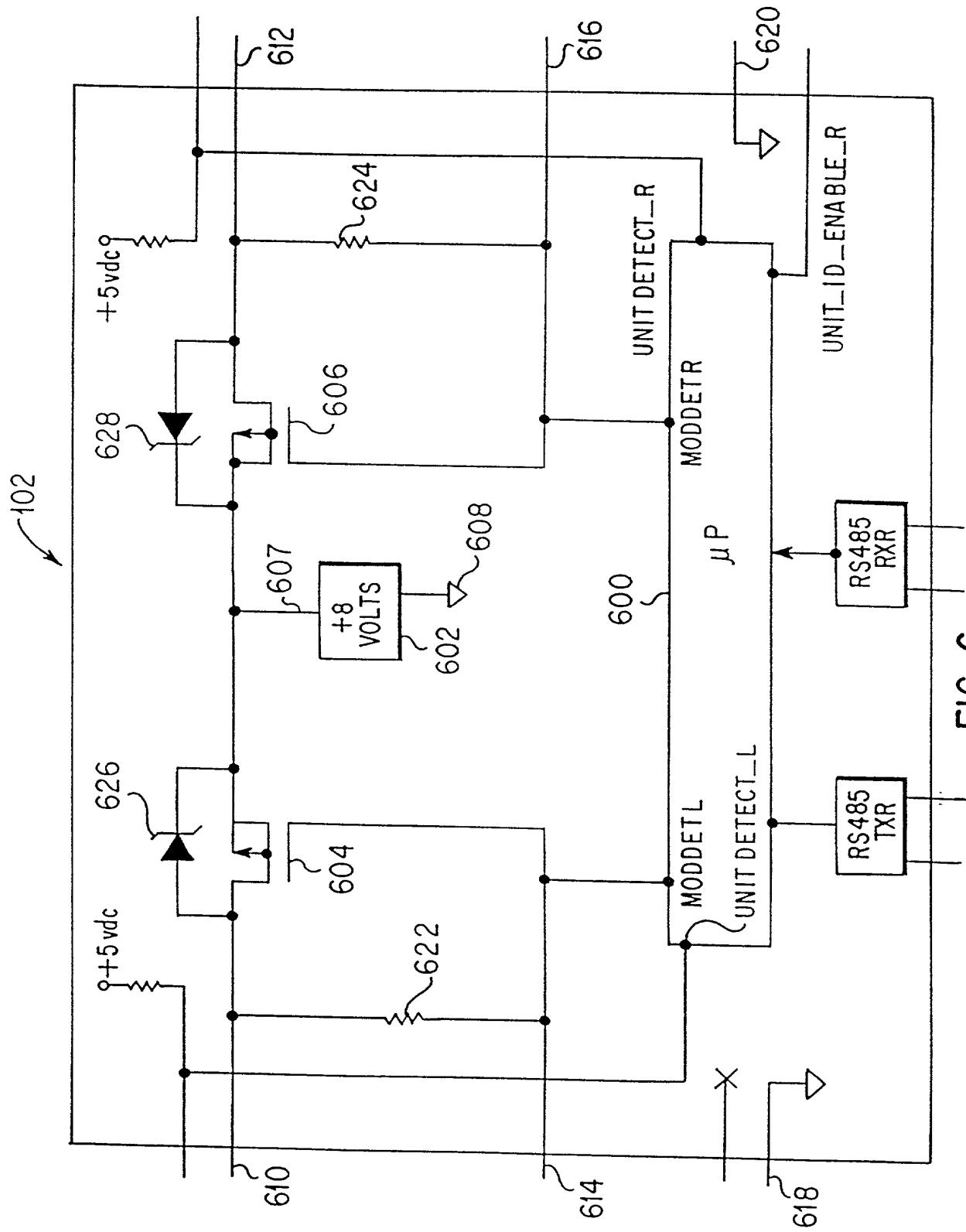


FIG. 6

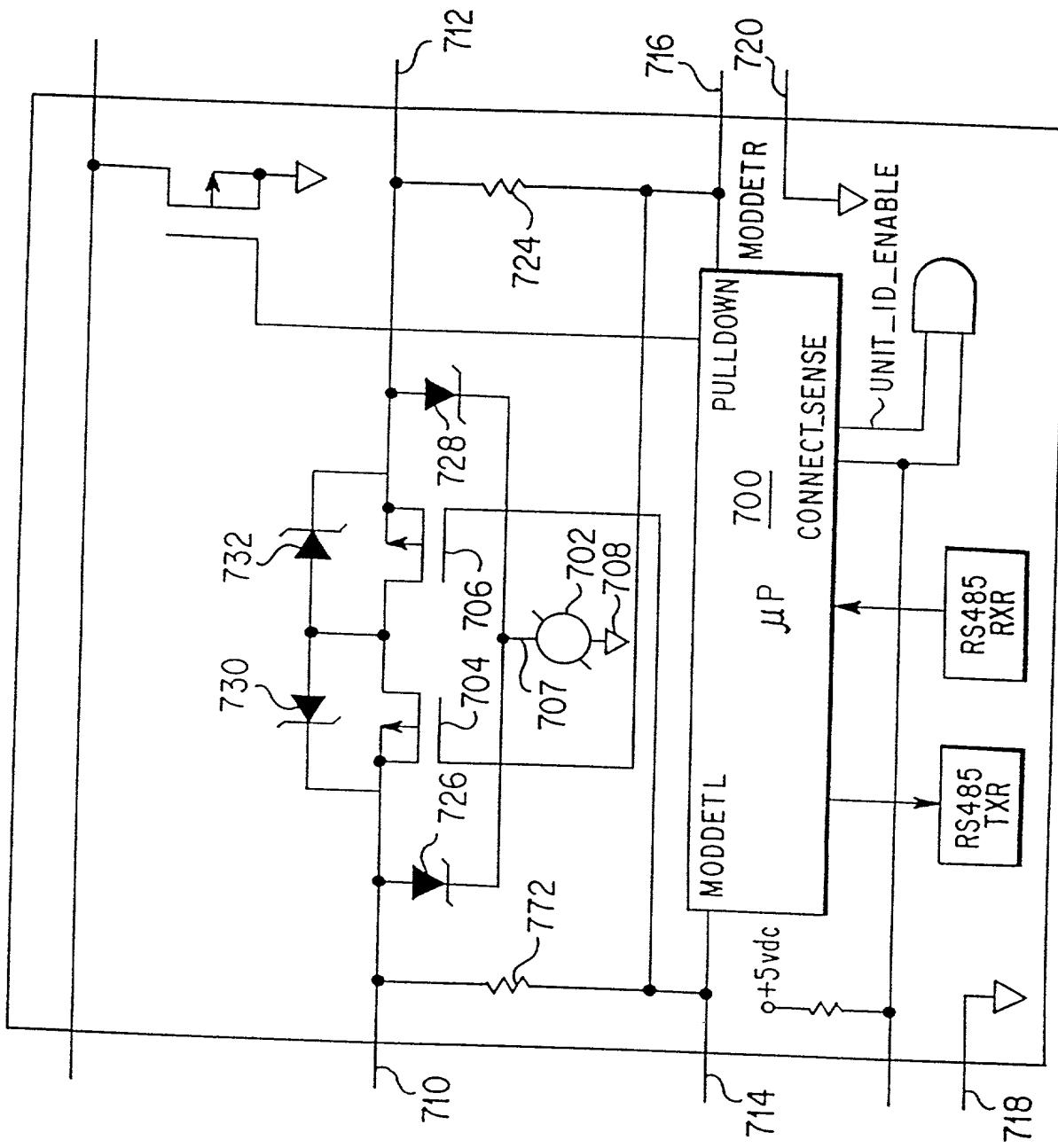


FIG. 7

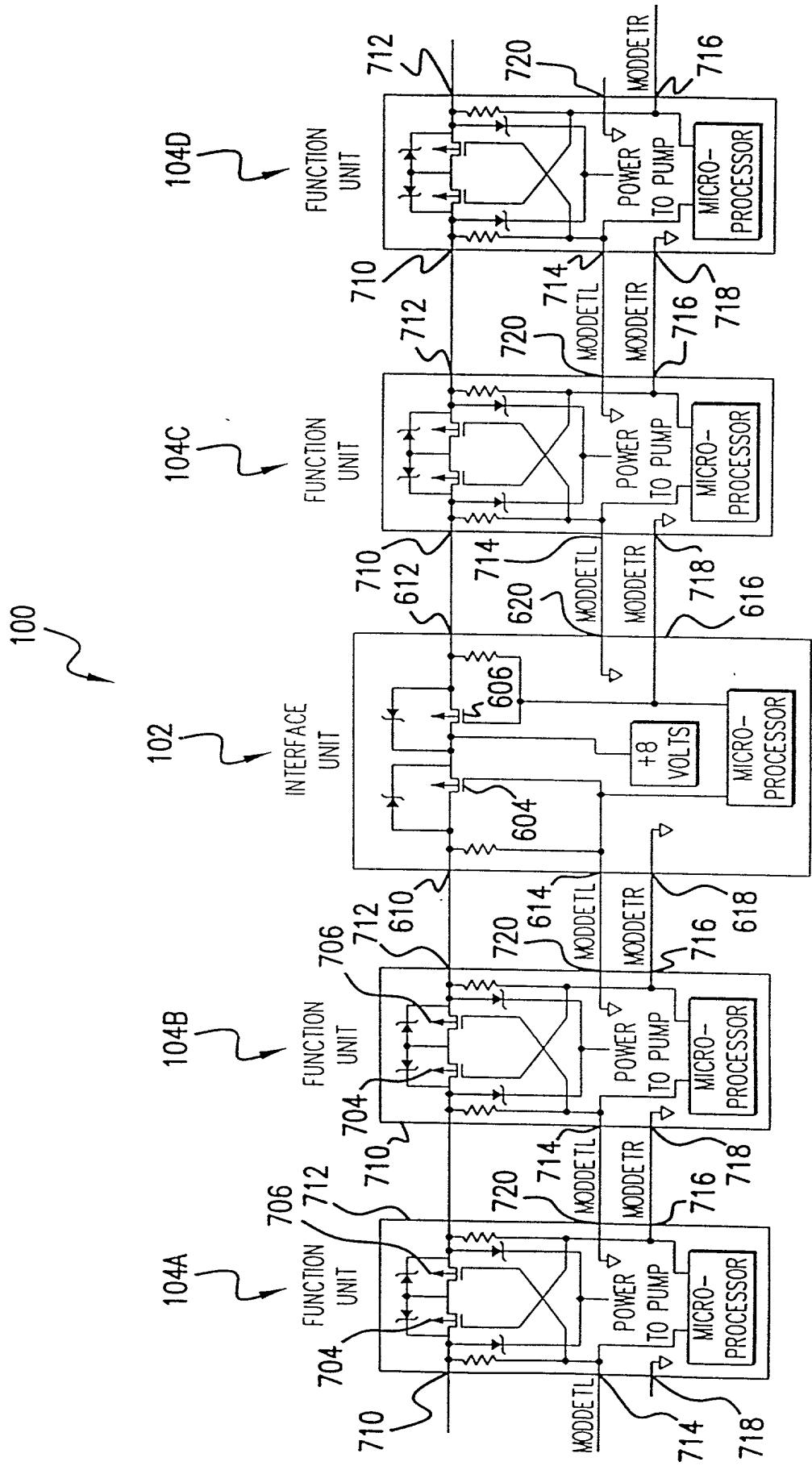


FIG. 8

**DECLARATION
AND POWER OF ATTORNEY**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below at 201 et seq. underneath my name.

I believe I am the original, first and sole inventor if only one name is listed at 201 below, or an original, first and joint inventor if plural names are listed at 201 et seq. below, of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND APPARATUS FOR POWER CONNECTION IN A MODULAR PATIENT CARE SYSTEM

and for which a patent application:

is attached hereto

was filed in the United States on _____ as Application Serial No. _____ (for declaration not accompanying application)
with amendment(s) filed on _____ (if applicable)

was filed as PCT international application Serial No. _____ on _____ and was amended under PCT Article 19
on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified application, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

EARLIEST FOREIGN APPLICATION(S), IF ANY, FILED PRIOR TO THE FILING DATE OF THE APPLICATION			
APPLICATION NUMBER	COUNTRY	DATE OF FILING (day, month, year)	PRIORITY CLAIMED
			YES <input type="checkbox"/> NO <input type="checkbox"/>
			YES <input type="checkbox"/> NO <input type="checkbox"/>

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

APPLICATION NUMBER	FILING DATE

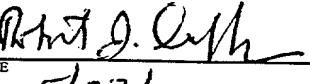
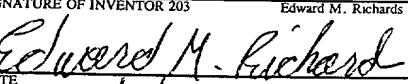
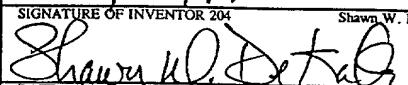
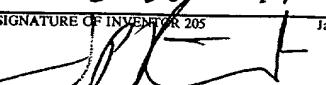
I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NO.	FILING DATE	STATUS		
		PATENTED	PENDING	ABANDONED

POWER OF ATTORNEY: As a named inventor, I hereby appoint S. Leslie Misrock (Reg. No. 18872), Harry C. Jones, III (Reg. No. 20280), Berj A. Terzian (Reg. No. 20060), Gerald J. Flintoft (Reg. No. 20823), David Weild, III (Reg. No. 21094), Jonathan A. Marshall (Reg. No. 24614), Barry D. Rein (Reg. No. 22411), Stanton T. Lawrence, III (Reg. No. 25736), Isaac Jarkovsky (Reg. No. 22713), Joseph V. Colaianni (Reg. No. 20019), Charles E. McKenney (Reg. No. 22795), Philip T. Shannon (Reg. No. 24278), Francis E. Morris (Reg. No. 24615), Charles E. Miller (Reg. No. 24576), Gidon D. Stern (Reg. No. 27469), John J. Lauter, Jr. (Reg. No. 27814), Brian M. Poissant (Reg. No. 28462), Brian D. Coggio (Reg. No. 27624), Rory J. Radding (Reg. No. 28749), Stephen J. Harbulak (Reg. No. 29166), Donald J. Goodell (Reg. No. 19766), James N. Palik (Reg. No. 25510), Thomas E. Friebel (Reg. No. 29258), Laura A. Coruzzi (Reg. No. 30742), Jennifer Gordon (Reg. No. 30753), Jon R. Stark (Reg. No. 30111), Allan A. Fanucci (Reg. No. 30256), Geraldine F. Baldwin (Reg. No. 31232), Victor N. Balancia (Reg. No. 31231), Albert P. Halluin (Reg. No. 25227), Samuel B. Abrams (Reg. No. 30605), Steven I. Wallach (Reg. No. 35402), Marcia H. Sundein (Reg. No. 30893), Paul J. Zegger (Reg. No. 33821), Edmond R. Bannon (Reg. No. 32110), Bruce J. Barker (Reg. No. 33291), Adriane M. Antler (Reg. No. 32605), Ann L. Gisolfi (Reg. No. 31956), SaraLynn Mandel (Reg. No. 31853), Mark A. Farley (Reg. No. 33170), James G. Markey (Reg. No. 31636), and Charles F. Hoyng (Reg. No. 35548), all of Pennie & Edmonds, whose addresses are 1155 Avenue of the Americas, New York, New York 10036, 1667 K Street N.W., Washington, DC 20006 and 2730 Sand Hill Road, Menlo Park, CA 94025, and each of them, my attorneys, to prosecute this application, and to transact all business in the Patent and Trademark Office connected therewith.

SEND CORRESPONDENCE TO:		PENNIE & EDMONDS 1155 AVENUE OF THE AMERICAS NEW YORK, N.Y. 10036-2711		DIRECT TELEPHONE CALLS TO: PENNIE & EDMONDS DOCKETING (212) 790-2803	
201	FULL NAME OF INVENTOR	LAST NAME Duffy	FIRST NAME Robert	MIDDLE NAME J.	
	RESIDENCE & CITIZENSHIP	CITY Poway	STATE OR FOREIGN COUNTRY California	COUNTRY OF CITIZENSHIP USA	
	POST OFFICE ADDRESS	STREET 16405 Summer Sage Road	CITY Poway	STATE OR COUNTRY California	ZIP CODE 92064
202	FULL NAME OF INVENTOR	LAST NAME Severe	FIRST NAME Lon	MIDDLE NAME M.	
	RESIDENCE & CITIZENSHIP	CITY San Diego	STATE OR FOREIGN COUNTRY California	COUNTRY OF CITIZENSHIP USA	
	POST OFFICE ADDRESS	STREET 5655 Guincho Ct.	CITY San Diego	STATE OR COUNTRY California	ZIP CODE 92124
203	FULL NAME OF INVENTOR	LAST NAME Richards	FIRST NAME Edward	MIDDLE NAME M.	
	RESIDENCE & CITIZENSHIP	CITY Pleasanton	STATE OR FOREIGN COUNTRY California	COUNTRY OF CITIZENSHIP USA	
	POST OFFICE ADDRESS	STREET 6693 Hansen Dr.	CITY Pleasanton	STATE OR COUNTRY California	ZIP CODE 94566
204	FULL NAME OF INVENTOR	LAST NAME DeKalb	FIRST NAME Shawn	MIDDLE NAME W.	
	RESIDENCE & CITIZENSHIP	CITY San Deigo	STATE OR FOREIGN COUNTRY California	COUNTRY OF CITIZENSHIP USA	
	POST OFFICE ADDRESS	STREET 12674 Buckwheat Court	CITY San Diego	STATE OR COUNTRY California	ZIP CODE 92129
205	FULL NAME OF INVENTOR	LAST NAME Stewart	FIRST NAME James	MIDDLE NAME P.	
	RESIDENCE & CITIZENSHIP	CITY El Cajon	STATE OR FOREIGN COUNTRY California	COUNTRY OF CITIZENSHIP USA	
	POST OFFICE ADDRESS	STREET 1391 Helix View Drive	CITY El Cajon	STATE OR COUNTRY California	ZIP CODE 92020
206	FULL NAME OF INVENTOR	LAST NAME	FIRST NAME	MIDDLE NAME	
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP	
	POST OFFICE ADDRESS	STREET	CITY	STATE OR COUNTRY	ZIP CODE

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201 	Robert J. Duffy	SIGNATURE OF INVENTOR 202 	Lon M. Severe	SIGNATURE OF INVENTOR 203 	Edward M. Richards
DATE 5/27/97	DATE 5-28-97	DATE 6/4/97			
SIGNATURE OF INVENTOR 204 	Shawn W. DeKalb	SIGNATURE OF INVENTOR 205 	James P. Stewart	SIGNATURE OF INVENTOR 206	
DATE 5/27/97	DATE 5/28/97	DATE			